Indirect costs of back pain in the Netherlands: a comparison of the human cpital method with the friction cost method

Hutubessy, R.C.W.; van Tulder, M.; Vondeling, H.; Bouter, L.M.

published in
Pain
1999

DOI (link to publisher)
10.1016/S0304-3959(98)00204-8

document version
Publisher's PDF, also known as Version of record

PAIN

Pain 80 (1999) 201–207

Indirect costs of back pain in the Netherlands: a comparison of the human capital method with the friction cost method

Raymond C.W. Hutubessy, Maurits W. van Tulder*, Hindrik Vondeling, Lex M. Bouter

Institute for Research in Extramural Medicine, Faculty of Medicine, Vrije Universiteit, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands

Received 23 February 1998; received in revised form 25 September 1998; accepted 6 October 1998

Abstract

In this study we estimated the indirect costs of back pain in 1991 in the Netherlands on the basis of two approaches: the traditionally used human capital method and the more recently developed friction cost method. The indirect costs of illness were defined as the value of production losses of paid labour and related costs to society due to back pain. The results of this study in 1991 in the Netherlands show that the short-term indirect costs estimated by the human capital method were more than three times as high as the indirect costs estimated by the friction cost method (US$ 4.6 billion vs. US$ 1.5 billion, respectively). The lower estimate of indirect costs when using the friction cost method is mainly due to the fact that in this method actual production losses are estimated during a relatively short friction period, which is defined as the period needed to restore the initial production level. In contrast with the human capital method, long-term absenteeism and disability do not induce additional costs when applying the friction cost method. Since the friction cost method takes into account that employees can be replaced, we believe that this method produces a more accurate estimate of indirect costs than the human capital method. Notwithstanding the resulting decrease in indirect costs of back pain, these costs are still impressive, representing 0,28% of the GNP in the Netherlands in 1991. As a consequence, but particularly stimulated by structural changes in the Dutch social security system, policies aimed at reducing indirect costs of back pain, increasingly concentrate on the development and evaluation of interventions early after the onset of disease. This is complemented, on the one hand, by the development of clinical guidelines for the management of back pain in primary care and, on the other hand, by governmental policies aimed at reintegration of chronically ill in the labour force.

Keywords: Cost of illness; Indirect costs; Back pain; The Netherlands

1. Introduction

Back pain is a major health problem in Western industrialized countries. Not only the frequency of back pain, expressed as incidence or prevalence figures, but also the monetary impact of back pain on society is tremendous (van Tulder et al., 1995). For example, the direct health care costs of musculoskeletal diseases (US$ 1.4 billion), were the fourth highest in the Netherlands in 1988, accounting for 6.6% of the total health care costs in that year. Furthermore, the total costs of low back pain in the Netherlands were estimated about US$ 5 billion in 1991 (van Tulder et al., 1995). In 1990 direct costs of low back pain were estimated to amount to US$ 24.3 billion in the United States. Indirect costs were estimated to vary from 75 to 100 billion US$ (Frymoyer and Cats-Baril, 1991).

In The Netherlands, policy-makers increasingly recognise the financial impact of absenteeism and disability, to which back pain is constitutive. After a transition period, in 1996, legislative changes were enforced which resulted in the obligation of employers to pay 100% of the wages of employees during absenteeism for a period of 1 year. These measures replaced the Sickness Benefit Act, creating financial incentives for employers to reduce absenteeism as much as possible. At the same time, the eligibility criteria for the Disability Insurance Act were redefined, imposing more

* Corresponding author. Tel: +31-20-444-8178, fax: +31-20-444-8181; e-mail mw.van-tulder.emgo@med.vu.nl

0304-3959/99/$ - see front matter
PII: S0304-3959(98)00204-8

strict criteria for new patients and implying a reassessment of every person receiving a disability pension. Several incentives for these policy measures have been identified of which the most important is probably the anticipated difficulty of maintaining a high level social security system in the future, due to the ageing of the population. Many other Western industrialized countries have to deal with similar policy issues.

Relevant input for policy-making regarding absenteeism and prevention of chronic disorders are the data on the burden of diseases to society. The most common method to estimate the burden of disease on society in economic terms is a cost of illness (COI) study (Rice, 1966; Hodgson and Meiners, 1982). The costs at issue are usually classified as direct costs inside or outside the health care sector and indirect costs outside the health care sector (Drummond et al., 1987). Methodological consensus on estimating indirect costs is lacking (Hodgson, 1994). In this study indirect costs are considered as the current and future output losses of paid labour due to reduced productivity caused by absenteeism and disability related to back pain.

The most frequently used approach in COI studies to estimate the indirect costs is the human capital method. According to this approach, potential loss of productivity is quantified in terms of forgone earnings, assuming full productivity (Hodgson, 1994). The concept underlying the human capital method is that an individual produces a stream of output over the years that is valued as individual earnings, with the value of household work being imputed. The individual rate of pay is assumed to be equal to the value of a person's labour activity. Koopmanschap and Rutten (1996) speak of 'potentially lost production' as a consequence of disease, whereby short-term absence and long-term disability would have been spent in full productivity. More commonly, indirect costs are estimated on the basis of standard labour wages which can be collected empirically.

A recently developed alternative approach is the friction cost method, which estimates the indirect costs by calculating the production losses caused by sick leave during a friction period. The friction period is defined as the number of days needed to restore the initial production level. It is assumed that employees who are on sick leave will be replaced after completion of the friction period (Koopmanschap et al., 1995). If sick leave is shorter than the friction period, a corresponding fraction of the friction costs is taken as indirect costs of back pain. For example, if an employee has been on sick leave for 30 days, while the friction period has been estimated to be 90 days, then obviously the production losses of all these 30 days will be taken into account. However, if an employee has been on sick leave for 120 days, production losses will be limited to the friction period of 90 days.

In this article we will compare the traditionally used human capital method with the friction cost method in estimating the indirect costs of back pain in the Netherlands in 1991.

2. Methods

In COI studies prevalence-based or incidence-based data can be used. The prevalence-based method relies on the assumption that costs should be assigned to the year in which they are incurred or to the year with which they are directly associated (Hodgson, 1994). In this study we compared the human capital method and the friction cost method in estimating the indirect costs of back pain in the Netherlands in 1991 using prevalence-based data. All costs are presented in US dollars using the average exchange rate in 1991 (DFL 1.88 = US$ 1.00). Lack of information prevented us from also estimating the indirect costs of unpaid labour and of illness without absence, resulting in reduced productivity while on the job. As advocated by many researchers, a societal perspective is applied in the analysis (Friedman, 1982). Consequently, the economic or welfare costs of back pain are expressed in terms of its contribution to the gross national product (GNP).

The most important source of data were the annual figures for 1991 from the Social Insurance Council in the Netherlands (Social Insurance Council, 1992). In 1991, the social security system in the Netherlands was based on three laws which stipulated compulsory insurance for the loss of income due to sickness, injury or disability. Under the Sickness Benefit Act, workers received sick pay during absenteeism, for a maximum of 52 weeks. If a worker was still unable to work after 52 weeks, he/she was entitled to a disability pension covered by the Disablement Insurance Act. This disability pension amounted to 70% of the last earned wage in the case of full disablement. The Disablement Insurance Act also provided the possibility of partial disablement pay or holiday pay (van Tulder et al., 1995). People who were not employed prior to disablement were covered by the General Disablement Act.

A diagnosis was only registered after examination of the employee by a medical adviser of an insurance company, which was usually scheduled 6 weeks after initiation of the complaints. The Social Insurance Council determined disease categories according to the International Classification of Disease (ICD). In this study the ICD codes 720-724 (dorsopathies) are used to define back pain. To estimate the total indirect costs of back pain, we assume that the proportion of back pain among those on sick leave for less than 6 weeks (no diagnosis) was equal to the proportion among those on sick leave for more than 6 weeks (registered diagnosis).

2.1. Human capital method

We estimated the indirect costs of back pain according to the human capital method by multiplying the total number of sick-days due to absenteeism and disablement by the mean costs of 1 sick-day or by the mean disability pension per day. Both the sick-day pay and the disability pension per day are extrapolated to the last earned wage of the sick employee.

To estimate the total indirect costs of absenteeism of the entire labour force in the Netherlands in 1991 we had to make some extrapolations. Firstly, since the registration of payments under the Social Benefit Act only covers 80% of all insured employees, the total costs of the industrial insurance boards were extrapolated to 100%. Secondly, about 70% of all employees in the Netherlands are insured under the Social Benefit Act, the remaining 30% are insured by private companies. Therefore, under the assumption that absenteeism of privately insured people is equal to that of publicly insured people, we also extrapolated these costs to 100%.

Besides these insurance costs, the Social Benefit Act also involves administration costs. In 1991 the total administration costs amounted to 8.7% of the total insurance costs. The administration costs of back pain were estimated by adding this proportion to the insurance costs of back pain.

2.2. Friction cost method

The indirect costs according to the friction cost method were estimated by multiplying the number of sick-days due to absenteeism by income and elasticity for annual labour time versus labour productivity.

The number of sick-days due to low back pain were based on annual figures for 1991 from the Social Insurance Council in the Netherlands. The friction period was estimated to last 3 months. The length of the friction period was based on the average vacancy duration, which depends on the level of unemployment and on the efficiency of the labour market in matching labour demand and supply (Koopmanschap et al., 1995). These estimates may therefore vary among countries.

Income was estimated using data of the Netherlands Central Bureau of Statistics (CBS) stratified by age, sex and education level (Koopmanschap et al., 1995). We did not have data documenting back pain patients according to education level in the Netherlands. However, studies in the United States reported that the majority of back pain patients are employed in manufacturing and construction, trades, material handling, transport and labouring tasks requiring physical effort (Behrens et al., 1994; Crook and Moldofsky, 1994). These types of labour are associated with an extended basic level of education. Therefore, we used an extended basic level of education in our estimate of income of back pain patients in the Netherlands.

Elasticity refers to elasticity for annual labour time versus average labour productivity. If absence from work reduces the effective labour time proportionally, i.e. 1 month of absence from work results in 1 month of production losses, no correction would be needed. However, since absence from work reduces the effective labour time less than proportionally this elasticity is required. We used the estimate of elasticity of 0.8 in the Netherlands as published by the Dutch Economic Institute (de Koning and Tuyl, 1984). This means that 1 month of absence from work corresponds to 80% actual production losses for that month and that 20% of the production has not been lost, for example due to internal labour reserves.

To estimate the total indirect costs of absenteeism of the entire labour force in the Netherlands in 1991 we had, similarly to what we did for the human capital method, to extrapolate to 100% for the registration of payments and insured employees under the Social Benefit Act.

2.3. Sensitivity analysis

We estimated the friction costs of low back pain under baseline assumptions, assuming an extended basic level of education for the whole study population. To test the effect of alternative education levels on indirect costs using the friction cost method, we varied some of the baseline assumptions. We calculated a higher bound estimate assuming that all patients had an intermediary level of education, and a lower bound estimate assuming a basic education level for all patients. The friction period for employees with a basic education and an intermediary education is 2.8 months and 3.3 months, respectively (Koopmanschap et al., 1995).

A sensitivity analysis was also performed for the elasticity for annual labour time versus labour productivity assuming an elasticity of 0.7 and 0.9, instead of 0.8.

3. Results

Table 1 shows the prevalent cases of absenteeism and

Table 1

Prevalent cases of absenteeism and disablement due to back pain (ICD 720-724) by gender in the Netherlands in 1991

	Men		Women		Total	
	number	%	number	%	number	%
Total absenteeism	356 770	70	153 584	30	510 354	100
< 6 Weeks absenteeism	251 441	71	101 411	29	352 852	100
>6 Weeks absenteeism	105 329	67	52 173	33	157 502	100
Total disability	101 004	71	42 151	29	143 155	100
Total absenteeism and disability	457 774	70	195 735	30	653 500	100

disablement in the Netherlands in 1991 due to back pain according to the ICD codes 720-724.

3.1. Human capital method

The mean costs per sick-day in 1991 amounted to US$ 67 for men and US$ 37 for women (van Tulder et al., 1995). The mean daily disability pension in 1991 was US$ 55 for men and US$ 37 for women, resulting in indirect costs of more than US$ 1.5 billion. As presented in Table 2, the costs of absenteeism accounted for more than two thirds of these costs, and the costs of disablement accounted for about one third of the total indirect costs of back pain. After extrapolation, the total indirect costs of back pain amounted to US$ 4.6 billion.

3.2. Friction cost method

Table 2 shows the annual short-term indirect costs of back pain based on the friction cost method. The total indirect costs of back pain in 1991, estimated on the basis of the friction cost method, amounted to US$ 666 million for men and US$ 176 million for women. The total extrapolated short-term indirect costs of back pain were about US$ 1.5 billion, assuming the back pain population to have an extended basic level of education.

3.3. Sensitivity analysis

The results of the sensitivity analysis are presented in Table 3. As detailed data on the education level of the Dutch labour force with back pain are lacking, we assumed for the lower-bound estimate a basic level of education. In this situation, the extrapolated friction costs of absenteeism were estimated at about US$ 1 billion for men and about US$ 260 million for women in 1991, which is, respectively, 7 and 17% lower compared with the baseline variant. When we alternatively assume the total labour force with back pain to have an intermediary level of education, the friction costs are substantially higher: more than US$ 1.6 billion for men and US$ 462 million for women. This equals an increase of about 38% for men and 47% for women, compared with the baseline variant, which is due to both higher production values and longer friction periods.

Another factor to consider is the elasticity for annual labour time versus labour productivity. We used an estimate of 0.8 reported by the Dutch Economic Institute (de Koning and Tuyl, 1984). It is unclear whether or not this is representative for firms employing the back pain population. If, for example, due to a relatively high internal labour reserve in firms employing workers suffering from back pain, the elasticity for annual labour time versus labour productivity would be 0.7, this would result in a 12.5% (1/8) reduction of indirect costs (US$1.3 billion under this assumption, compared to US$1.5 billion in the baseline calculation). A corresponding increase of indirect costs of 12.5% (1/8) would result when assuming 0.9 as the actual elasticity value.

Table 2
Annual indirect costs of back pain (ICD 720-724) in the Netherlands in 1991 (million US$)

	Human capital method			Friction costs method
	Absenteeism	Disablement	Total	Absenteeism
Costs				
Men	415*	765	1180	666
Women	124*	241	365	176
Total	539*	1006	1545	842
Extrapolated costs	3104	1509	4613	1504

*The category ‘no diagnosis’, which accounts for 35% of the total costs of absenteeism, is excluded.

4. Discussion

The aim of this study was to compare two different methods of quantifying indirect costs of back pain in the Netherlands in 1991, the human capital method and the friction cost method. When using the human capital method, the indirect costs of back pain in the Netherlands were estimated at US$4.6 billion (van Tulder et al., 1995), while in this study the indirect costs of back pain were estimated at US$1.5 billion when using the friction cost method. As a consequence, the proportion of the indirect costs to the total costs (direct health care costs added to indirect costs) of back pain using the friction cost method are relatively small (30%) compared with the human capital method (95%). In general, as the friction cost method assumes production loss to be limited to the short run, indirect cost for diseases that mainly cause disability and mortality are much lower based on the friction cost method compared to the human capital method. For diseases entailing short-term absence, e.g. migraine, the difference is much smaller (Koopmanschap et al., 1995).

Other studies on back pain, based on the human capital method, show a wide range of reported values of the contribution of indirect costs to the total costs: 13–19% in the US (Grazier et al., 1984; Frymoyer and Cats-Baril, 1991), 25% in the UK (Moffet et al., 1995), and 95% in Sweden (Jonsson, 1990). It should be noticed that comparisons between these international studies should be made with extreme care because of, for example, differences between health care systems and social security systems.

Consensus is lacking with respect to the measurement of indirect costs. Opponents of the friction cost method have argued that this method, in contrast to the human capital method, is not based on plausible assumptions supported by neoclassical economic theory (Johannesson and Karlsson, 1997). According to the neoclassical point of view, economies are characterized by continuous full employment equilibrium, instantaneously adapting to disturbances. In their

Table 3

Sensitivity analysis of indirect costs of back pain for education level in the friction cost method

	Friction costs by gender					
	Men		Women		Total	
	US$ millions	% Difference	US$ millions	% Difference	US$ millions	% Difference
Basic education	1037	(–13)	260	(–17)	1297	(–14)
Extended basic	1190	–	314	–	1504	–
Intermediary	1641	(+38)	462	(+47)	2103	(+40)
Higher vocational	2175	(+83)	644	(+105)	2819	(+87)
University	2924	(+146)	819	(+161)	3743	(+149)

reply, Koopmanschap et al. (1995) argue that this is unrealistic as substantial unemployment is common. We refer readers who are interested in more detailed information to the discussion of this issue in both papers (Johannesson and Karlsson, 1997; Koopmanschap et al., 1995). Although the friction cost method induces a marked reduction in indirect costs of back pain, these costs are still impressive, representing 0.28% of the GNP in the Netherlands in 1991. We believe that accurate estimates of indirect costs as calculated with the friction cost method as part of a COI study are helpful in health policy decisions. COI studies have been criticized for their inability to serve as a component in evaluating alternative demands on scarce health care resources since the cost estimates do not provide any information on the effectiveness of these alternatives. However, we agree with proponents of COI studies that they may be useful in estimating disease costs covering the entire classification of diseases, enabling mutual comparison of disease costs and putting these in perspective, in prioritising diseases or topics for future economic evaluation, and in clarifying the most important cost components of treating specific diseases.

4.1. Generalizability

When applying the friction cost method it should be noticed that the results may change over time within a country, among other factors depending on the macroeconomic context. For example, registered unemployment was 8.2% in 1990 in the Netherlands, resulting in an average friction period of 2.8 months (Koopmanschap et al., 1995). In the past years, unemployment has markedly decreased in the Netherlands to 4.5% (April 1998, The Economist), implying that the current friction period may be longer than the friction period for 1990. If so, the actual indirect costs estimated by the friction cost method will be higher when the study would be updated.

Application of the friction cost method to calculate indirect costs of back pain in countries other than the Netherlands can not be performed without adjusting for country-specific social security arrangements and the macroeconomic context. For example, disability in the Netherlands is not included in the friction cost method because a disability pension is rewarded after 52 weeks of sick leave and the friction period was estimated to be about 3 months. In other countries with a different social security system where disability pensions are rewarded sooner, i.e. within the duration of the friction period for that country, disability may also contribute to indirect costs. Also the length of the friction period will vary between countries. In general, the length of the friction period is based on the average vacancy duration, which depends on the level of unemployment and on the efficiency of the labour market in matching labour demand and supply (Koopmanschap et al., 1995).

4.2. Uncertainties

Accepting the friction cost method does not imply that all disadvantages of the human capital method are resolved. Still many uncertainties have to be addressed when using the friction cost method. The sensitivity analysis in our study shows that the indirect costs of back pain heavily depend on the average education level of the population.

No data were available on the absenteeism of the privately insured. We estimated total indirect costs under the assumption that the prevalence of back pain in the privately insured was equal to that of the publicly insured. If this has resulted in an underestimation due to the of the higher average daily sick pay or to an overestimation due to the lower absenteeism among the privately insured remains unknown. It is likely that these contrasting trends would result in only modest changes.

There were also no data available on the diagnoses of people on sick leave for less than 6 weeks. We estimated the indirect costs under the assumption that the proportion of back pain among those on sick leave for less than 6 weeks was the same as for those on sick leave for more than 6 weeks. Due to the favourable natural history of back pain in the first weeks, the proportion of people with back pain will probably be higher among those with less than 6 weeks sick leave. However, it is expected that this will only result in minor changes in total indirect costs as people with long-term sick leave are responsible for the majority of costs.

Indirect costs may be underestimated, due to the absence of data, the influence of reduced productivity of work while on the job was not taken into account. In addition, estimates of indirect costs should incorporate production loss in rela-

tion to unpaid labour, e.g. by housewives, pensioned elderly and the unemployed, to prevent adverse equity implications. Due to a lack of data only paid labour was taken into account in this study. The same criticism can be applied to a calculation of indirect costs of back pain using the human capital method.

4.3. Choice of perspective and clinical implications

We have applied a societal perspective in calculating the indirect cost of back pain since this is the most comprehensive perspective in an economic evaluation. However, at a macroeconomic level, other perspectives could be of interest as well (Weinstein, 1990; Hutton and Persson, 1995). In the Netherlands, as outlined in the introduction, the perspective of employers has become more prominent as a result of a number of legislative changes. Recently, employers have started to develop and evaluate interventions aimed at reducing absenteeism. In the case of back pain, interventions such as 'graded activity' programmes or back schools are considered by Dutch employers to promote a rapid return to work of their sick employees, but also to prevent work-related disorders.

Coinciding with this trend, several clinical guidelines for the management of low back pain in primary care have recently been published (Bigos et al., 1994; Rosen et al., 1994; Faas et al., 1996; Waddell et al., 1996). According to these guidelines, prevention of chronicity and of medicalization should be the main objective in the management of low back pain in primary care. In the acute phase a wait-and-see policy aimed at reassuring the patient is the most appropriate management option. Patient education and advice to continue usual activities may result in reducing the incidence of chronic disability and in less time off work. If the complaints persist for 6 weeks or more, emphasis on return to work and resumption of normal daily activities become the most important objectives. Exercise therapy is probably the most useful treatment option general practitioners have for this purpose (Bigos et al., 1994; Rosen et al., 1994; Faas et al., 1996; Waddell et al., 1996). The relatively low costs of treatment, compared with the high costs due to absenteeism and disablement, indicate that even long-term marginally effective treatment might be cost-effective. In a recent review of economic evaluations of back pain interventions it was concluded that most of the 23 studies identified, showed serious methodological shortcomings (Goossens and Evers, 1997). High quality economic evaluation studies, for example economic evaluation alongside clinical trials, are needed to increase the efficiency in health care and to support decision-making on the allocation of scarce resources.

Acknowledgements

We thank Professor H.D. Banta (The Netherlands Organization for Applied Scientific Research (TNO), Leiden, The Netherlands), Dr. M.A. Koopmanschap and Professor F.F.H. Rutten (Institute for Medical Technology Assessment (iMTA), Erasmus University Rotterdam, The Netherlands) for their comments on previous versions of this article.

References

Behrens, V., Seligman, P. and Cameron, L. et al., The prevalence of back pain, hand discomfort, and dermatitis in the US working population, Am. J. Publ. Health, 84 (1994) 1780–1785.

Bigos, S., Bowyer, O.R., Braen, G.R., Brown, K., Deyo, R., Haldeman, S., Hart, J.L., Johnson, E.W., Keller, R., Kido, D., Liang, M.H., Nelson, R.M., Nordin, M., Owen, B.D., Pope, M.H., Schwartz, R.K. Stewart, D.H., Susman, J., Triano, J.J. Tripp, L.C., Turk, D.C., Watts, C., Weinstein, J.N. Acute low back pain problems in adults. Clinical practice guideline no. 14. Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services. AHCPR Publication no. 95-0642. Rockville, MD, 1994.

Crook, J. and Moldofsky, H., The probability of recovery and return to work from the disability as a function of time, Qual. Life Res., 3 (1994) 97–109.

de Koning, J. and Tuyl, F.A.W.M., The relation between labour time, production and employment (in Dutch). Netherlands Economic Institute, Rotterdam, 1984.

Drummond, M.F., Stoddart, G.L. and Torrance, G.W., Methods for economic evaluation of health care programmes. Oxford Medical Publications, Oxford, 1987.

Faas, A., Chavannes, A.W., Koes, B.W., Van den Hodgen, J.M.M., Mens, J.M.A., Smeele, L.J.M., Romeijnders, A.C.M. and Van der Laan, J.R., NHG-standaard lage rugpijn, Huisarts Wet (in Dutch), 39 (1996) 18–31.

Friedman, M., Price theory. Aldine Publishing, Chicago, IL, 1982.

Frymoyer, J.W. and Cats-Baril, W.L., An overview of the incidences and costs of low back pain, Orthop. Clin. N. Am., 22 (1991) 263–271.

Goossens, M.E.J.B. and Evers, S.M.A.A., Economic evaluation of back pain interventions, J. Occup. Rehab., 7 (1997) 15–32.

Grazier, K.L., Holbrook, T.L. and Kelsey, J.L. The frequency of occurrence, impact, and costs of musculoskeletal conditions in the United States (1984). In: J.W. Frymoyer, W.L. Cats-Baril (Eds.), An Overview of the Incidences and Costs of Low Back Pain. Orthopedic Clinics North America Vol. 22, 1991,pp. 263–271.

Hodgson, T., Cost of illness in cost-effectiveness analysis: a review of the methodology, PharmacoEconomics, 6 (1994) 536–552.

Hodgson, T. and Meiners, M., Cost-of-illness methodology: a guide to current practices and procedures, Health Soc., 60 (1982) 429–461.

Hutton, J. and Persson, J., Technology and disability; assessment needs and potential, Int. J. Technol. Assess. Health Care, 11 (1995) 135–143.

Johannesson, M. and Karlsson, G., The friction cost method: a comment, J. Health Econom., 16 (1997) 249–255.

Jonsson, E., Economic impact. In: The Problem of Back Pain; Proceedings from a Conference. The Swedish Council on Technology Assessment in Health Care (SBU), Stockholm, Sweden, 1990.

Koopmanschap, M.A., Rutten, F.F.H., Van Ineveld, B.M. and van Roijen, L., The friction cost method for measuring indirect costs of disease, J. Health Econ., 14 (1995) 171–189.

Koopmanschap, M.A. and Rutten, F.F.H., A practical guide for calculating indirect costs of disease, PharmacoEconomics, 10 (1996) 460–466.

Moffet, J.K., Richardsson, G., Sheldon, T.A., Maynard, A. Back pain: its management and cost to society. Discussion paper 129, Centre for Health Economics, University of York, York, UK, 1995.

Rice, D.P., Estimating the Costs of Illness, Washington U.S. Government Printing Office, PHS Publ. No. 947-6, Health Economics series, Washington, WA, 1966.

Rosen, M., Breen, A., Hamann, W., Harker, P., Jayson, M.I.V., Kelly, E., Lloyd, P., McLean, E.K., Sears, C., Waddell, G. Report of a Clinical Standards Advisory Group Committee on Back Pain, HMSO, May 1994.

Social Insurance Council/Sociale Verzekeringraad. Stand ziekengeld verzekering 1991, Zoetermeer, The Nertherlands, 1992.

van Tulder, M.W., Koes, B.W. and Bouter, L.M., A cost-of-illness study of back pain in the Netherlands, Pain, 62 (1995) 233–240.

Waddell, G., Feder, G., McIntosh, A., Lewis, M. Hutchinson, A. (Eds.), Clinical guidlines for the management of acute low back pain. Low Back Pain Evidence review. Royal College of General Practitioners, London, UK, 1996.

Weinstein, M.C., Principles of cost-effective resource allocation in health care organisations, Int. J. Technol. Ass. Health Care, 6 (1990) 92–103